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ABSTRACT

This is a second report of a study of the use of scientific and technical information in industrial and nonprofit settings. It focuses on mapping the information-communication behavior of the engineering division of the Southwest Research Institute. Data include questionnaires, library records, travel records, telephone records, and contractual information. Categorization of levels of technical information potential shows the need for better description and differentiation of different kinds of high value information-communication behavior. Experimental changes in Southwest Research Institute operations are planned to study further the structure of information-communication behavior. (CH)

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Progress Report No. 2
September 1 through December 31, 1975
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THE EFFECTIVE USE OF SCIENTIFIC AND TECHNICAL INFORMATION
IN INDUSTRIAL AND NON-PROFIT SETTINGS:
EXPLORATIONS THROUGH EXPERIMENTAL INTERVENTIONS
IN ON-GOING R & D ACTIVITIES

Introduction -- The National Science Foundation awarded a grant to The University of Texas, "The Effective Use of Scientific and Technical Information in Industrial and Non-Profit Settings: Explorations through Experimental Interventions in On-Going R & D Activities" and work was begun on 2 June 1975.

As proposed, the study is being carried out in four steps. The steps include the following:

1. Development of a preliminary frame of reference
2. Design of interventions
3. Field implementation of interventions
4. Analysis and review of results

As reported in Progress Report No. 1, the first quarter was devoted primarily to activities concerned with:

1. The development of a preliminary frame of reference, and
2. The location of a suitable and willing cooperating organization.

The second quarter, reported here, has been focused on "mapping" the information-communication behaviors of a division of the cooperating organization, Southwest Research Institute (SRI).

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1. Data Collection -- For Initial Mapping
Data were collected in the Engineering Science Division of the cooperating organization. The surveyed division is located (as

are most of the major divisions of SRI) in a separate three story building. At the time of the initial data collection effort, a number of offices on the third floor of the building housed a Social Sciences unit which is not included in this initial effort.

The mapping data collection effort consisted of the following:

1. The administration of a questionnaire, and
2. The collection of library records, travel records, telephone records, and contractual information.

The questionnaire used was a slightly modified version of those used in previous research on communication and information flow in organizations (see Attachment 1). Thirty-six of the forty-four questionnaires distributed were completed and returned, and the questionnaire data combined with the data collected from documentary sources. The data have been entered into cards and tape.

Though not strictly required for our mapping effort, the data collected to date were analyzed to see if the kinds of data collected were adequate in their present form. As a consequence of the analysis, the questionnaire is being modified for the next mapping that will take place in the next quarter. The modifications include elimination of question 18 (see Attachment 1) and the definition that precedes it. Definitions will be more sharply delineated to avoid confusion. As should have been anticipated, perhaps, question 18 is confusing in the way it lumps together different kinds of information that are subsequently measured in the questionnaire.

The preliminary analysis of the data is shown in Attachment 2. The data analysis was primarily performed by a visiting scholar, Bjarne Ruby of Denmark, a visiting post doctorate research associate in the Department of Management, College of Business Administration, The University of Texas at Austin.

The analysis shown in Attachment 2 is a very preliminary effort. It employs a rather arbitrary rule for categorizing various levels of technical information potential; one that will be modified, now that we have the data on tape, by use of some form of multi-variate analysis. It uses the data collected by the question 18, referred to above, to help categorize individuals, and elimination of that question would shift some individuals from one category to another.

Despite the short comings discussed above, the analysis is included in this report. The results are of interest in many regards:

a. <u>With regard to age and experience</u> -- As might be expected, given more years in the organization and more years in which to gain acquaintanceship and knowledge, the competent "old timer" is more

likely to be considered as a source of technical information than the competent younger "new boy". From the viewpoint of our project, what becomes most interesting are the unexpected cases such as the younger newcomer who is turned to by his colleagues and the older worker, long with the organization, who is not now considered as a source of information.

What denotes the experience and behavior of the younger newcomer who is classified as very high in technical information potential? And what denotes the experience and behavior of the once productive worker who has "turned off"? What differentiates the older, high technical information potential individual from his parallel in age and organizational experience?

In terms of potential interventions; an effort to move an older worker, now classified as low in technical information potential, into a higher category would make sense and would also address one of the most poignant and critical questions facing research organizations.

b. On specialists as differentiated from others of high technical information potential -- The preliminary analysis and interviews in the organization being studied, point up the intuitively obvious, that there are many different forms or styles of high information potential. Those categorized as "specialists" (those being chosen by three or more of their colleagues as a source of one aspect of technical information) show interesting differences from the others studied. The specialists, during the period sampled, published less in journals but wrote more unpublished papers and reports than their colleagues. They were on the phone to outsiders more, travelled more, had fewer outside visitors and read less than the others. They were in fewer professional directories, and supervised fewer people than others of equal age and seniority in the organization. Of greatest interest, they tended to write to those outside the organization and those inside the organization to a far greater extent than their colleagues.

It is clear that we are looking at different kinds of high value information-communication behavior (at least from the viewpoint of colleagues), and it would be valuable to be able to better describe and differentiate these behaviors. It has been pointed out to us that one of those classified as an information star, a superhigh in our study, is a man who never really publishes, hardly telephones others, does not travel, is not in the first rank of "readers", "presenters" or the like. Yet, by all counts, he is one of those most designated as a source of information; he is a man who is ingenious in instrumentation problems. There are those who are vital to the performance of projects, men who are in constant communication with their colleagues, but not turned to for state-of-the-art. Many other special types of high technical information

potential become apparent as we become more familiar with the laboratory; thus, raising questions as to the styles and different functions that all fall within the envelope of high technical information potential. Hopefully, subsequent and better mappings combined with some form of multi-variate analysis might provide us with some kind of useful taxonomy of technical information potential.

c. The man in the middle -- Some of the differences described in our analysis can be explained in terms of the work dynamics of research organizations, particularly contract research institutes. The bulk of the "men in the middle" (i.e. project leaders, senior experienced workers) are those most likely to be engaged in developing new project possibilities and most fully engaged in managing as well as performing project work. Consequently, it is not surprising to find the professionals in their mid 30's and early 40's who have been with the organization five years or more to be most highly represented in terms of travel and long distance telephone calls. Thus, only one of the respondents who had recorded a trip during the sampled period was below 34 years old. Similarly, during the sampled period, only one of the young new workers registered a long distance call.

2. The Development of a Preliminary Frame of Reference

Efforts continue on a review of literature concerning information-communication behavior as part of the effort for development of a preliminary frame of reference. As part of the literature review undertaken, use is being made of available computerized search systems. A preliminary search was made using the Automatic Subject and Citation Alert (ASCA) of ISI.

The project team decided that it would be useful to take advantage of the opportunity thus presented to informally evaluate our experience with each search system used. The results of our experience with our first effort are presented here for information only (and are being sent to ISI). We would appreciate any suggestions as to improvement of our search modes; particularly since we find it ironic that it has been extremely difficult for us to get satisfactory search results in the field of information.

3. Interventions

A number of interventions have been considered and discussions are being conducted with the management of SRI to identify those interventions which are acceptable to them. Among the interventions being considered are the following:

a. Measurement of the subsequent effects on information-communication patterns of physical moves of staff (e.g. the Social Sciences unit has been moved out of the building. An individual

classified as high information potential is leaving. New senior men have been hired.

As can be seen in the attached analysis, there is an apparent high correlationship between location (i.e. next to the steps) and designation as a source of information. Since one of the high communicators with a "favorable" location is leaving, we will be able to measure the subsequent effects of location on a new office occupant.

b. Generation of an interdepartmental proposal preparation task force or work group to see the subsequent interdepartmental information-communication patterns resulting from a "natural" SRI activity involving different formal units. At present, there is little measured interaction between the different departments that are separated administratively, physically, and technically despite concern and efforts on the part of top management.

c. Modification of information-communication behavior of individuals in the direction of high technical information potential by the development and prescription of a set of designed activities. The prescribed activities would include those that denote individuals of high technical information potential and that carry with them a high probability of positive reinforcement. Appropriate activities might include a prescribed set of telephone calls to professional colleagues, face to face information requesting actions, the sending of formal and informal information to designated inside and outside colleagues.

The foregoing interventions would be maintained over a period of time in the expectation that information providing behavior, without economic or physical cost to the recipient, should elicit reciprocal information flows. This has been described by the sociological notion of the "norm of reciprocity" and by Garvey's studies of network behavior. If successful, the subjects should rise in ranking as designated sources of information in the subsequent mappings.

Albert Shapero

Albert Shapero
Principal Investigator

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ATTACHMENT 1

September 19, 1975

Dear Sir:

Who are the sources of scientific and technical information in a research organization? Do some professionals play different roles in the information environment?

The goal of this research is to get answers to these and many other questions of vital interest to the scientific professional. This study deals with an aspect of technical information flow in a working organization.

This is an independent study. Your replies will be held in strict confidence. The responses will be analyzed and reported back to you in group statistics. Your anonymity is guaranteed.

This study is unique in that it looks at the way an entire organization uses technical information. The research cannot be completed unless all questionnaires are returned. Your cooperation and thoughtful consideration will be greatly appreciated.

In completing this questionnaire, please consider Southwest Research Institute as "your organization".

Thank you very much.

Sincerely,

Albert Shapero

Albert Shapero
Professor of Management

AS:md

STUDY OF TECHNICAL INFORMATION FLOW

Below are some questions about your use of information and about sources of information in your organization. This form is being used in several very different organizations--from a college department to a physics laboratory--so questions will not fit your situation exactly. You will find some of the questions very difficult to answer; please give the best answer that you can.

1. Name _____ 2. Age _____

3. University training: Bachelors degree Date ____ Field _____

Masters degree Date ____ Field _____

Doctorate Date ____ Field _____

Some college Date ____ Field _____

4. How many years have you been with this organization? _____

5. How many years of technical experience do you have in the specific field in which you are currently working? _____

6. How many different organizations have you been with in your professional career? _____

7. Do you now have any connection with an academic institution as a teacher or part-time/full-time student? _____ If "Yes", please specify _____

8. What is your organization title or rank? _____

9. Are you a supervisor? _____ If "Yes", how many people do you supervise? _____

10. To how many different people do you report? _____

11. Do your duties require you to contact people outside of your own organization? _____

12. How many patent applications have you filed in the previous five years? _____

13. How many papers or articles have you published in the past five years? _____

14. In how many professional meetings have you been a participant (on the program or presenting a paper) in the past year? _____

15. How many unpublished papers or reports have you written in the past year? _____

16. Are you listed in professional directories? _____ How many? ___

17. What professional recognition (in the form of honors, awards, special committees, editorships, etc.) have you received in the past three years? _____

_____

_____

DEFINITION: For the purposes of this questionnaire, the term "Technical Information" is composed of:

(a) Project/task information--information related to the work to be done for a customer or client; contract specifications; research proposals; schedules and deadlines; costs; resource availability; etc.;

(b) State-of-the-art information--information related to the general scientific or technical capabilities of a scientific field or discipline; and

(c) Research/laboratory technique information--information related to the success or feasibility of different kinds of research and laboratory techniques.

_____

_____

18. Please name the three people in your organization who are the most likely sources of technical information for you.

(1) _____ (2) _____ (3) _____

19. Please name the two members of your organization who are the most likely sources of project/task information for you.

(1) _____ (2) _____

20. Please name the two members of your organization who are the most likely sources of state-of-the-art information.

(1) _____ (2) _____

21. Please name the two members of your organization who are the most likely sources of research/laboratory technique information for you.

(1) _____ (2) _____

22. How many technical or professional meetings have you attended during the past year? _____

23. Please list the professional journals or periodicals that you read in the average month.

_____ _____ _____

_____ _____ _____

_____ _____ _____

24. How many unpublished professional or scientific reports do you read in the average month? _____

25. How many of these unpublished reports originate outside of your organization? _____

26. With how many professional acquaintances from outside of your organization did you communicate during the past month? _____

27. With how many of these acquaintances did you discuss technical information? _____

28. How many of these outside acquaintances contacted last month do you consider within your technical field? _____

29. What other fields do these acquaintances represent? (example: electrical engineering, nuclear physics, etc.) _____
_____

30. How many of the outside communications contacts made last month with professional acquaintances were: face-to-face _____%
by phone _____% in writing _____%

31. With how many people in your organization do you regularly (once a month) communicate about: the project or task at hand? _____
the state-of-the-art in any field? _____
research/laboratory techniques? _____

32. Of the total number of communications that you make within your organization, how many are face-to-face? _____% by phone _____%
in writing? _____%

33. How many of the people referred to in Question 31 above do you consider to be in your field? _____

34. What fields or specialities are represented by the people you contact regularly in your organization? (example: personnel manager, chemist, propulsion expert, etc.) _____
_____

35. Please name the two members of your organization with whom you would most like to work.

(1) _____ (2) _____

THANK YOU VERY MUCH!!

ATTACHMENT 2

First Mapping

Bjarne Ruby*

The Effective Use of Scientific and Technical Information
in Industrial and Non-Profit Settings:
Explorations Through Experimental Interventions
in On-Going R & D Activities
NSF Grant SIS75-12725 (Shapero)

1. "Who Do You Go to For Information" and "Who Would You Like to Work With"

In the course of the study, the questionnaire respondents were asked to designate the first two (or three) of their professional colleagues according to five criteria. One of the five criteria was related to administrative responsibility; namely, "source of project/task information" and one was concerned with social aspects; namely, "like to work with". Three of the criteria were concerned with technical information potential. The three included "source of technical information", "source of state-of-the-art information", and "source of research/laboratory technique information". The expression "technical information potential" is used in this project to indicate the degree to which the technical professionals within an organization consider a colleague as a source of information relevant to the functions and purposes of the organization.

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*Bjarne Ruby was a Post-Doctoral Research Associate in the Department of Management, College of Business Administration, The University of Texas at Austin, Fall and Winter 1975.

In the questionnaire "technical information" was described as composed of:

a. Project/task information--information related to the work to be done for a customer or client; contract specifications; research proposals; schedules and deadlines; costs; resource availability; etc.,

b. State-of-the-art information--information related to the general scientific or technical capabilities of a scientific field or discipline, and

c. Research/laboratory technique information--information related to the success or feasibility of different kinds of research and laboratory techniques.

Depending upon the criterion used, between 78% and 90% of the choices were made of people within the division studied. The percentage choosing "outsiders" was highest for project/task information and lowest for "like to work with" choices.

About half of the members of the division were not designated as choices on any criterion whereas one-sixth received three or more choices (see Table 1.1). One person was outstanding as a source (first or second choice) of state-of-the-art information receiving 12 choices while another was named by ten colleagues as a source of research/laboratory technique information (see Table 1.2).

Table 1.1: Percentage of Individuals Designated as Sources of Selected Categories of Information

Number of times designated	Source of Information on: Project/ task (N=44)	Res./lab. technique (N=44)	Tech- nical (N=44)	State-of- the-art (N=44)	Like to work with (N=44)
10+	0%	2%	0%	2%	0%
9	0	0	0	0	2
8	5	0	2	0	0
7	0	0	2	5	2
6	2	0	0	0	0
5	5	2	2	0	0
4	2	5	5	0	0
3	2	11	2	9	14
2	7	11	25	20	16
1	16	23	18	7	18
0	61	45	43	55	48
TOTAL	100%	99%	99%	98%	100%

On the basis of the questionnaire responses, the members of the division were classified according to the way and extent to which they were designated as sources of technical information. The division members were classified as follows:

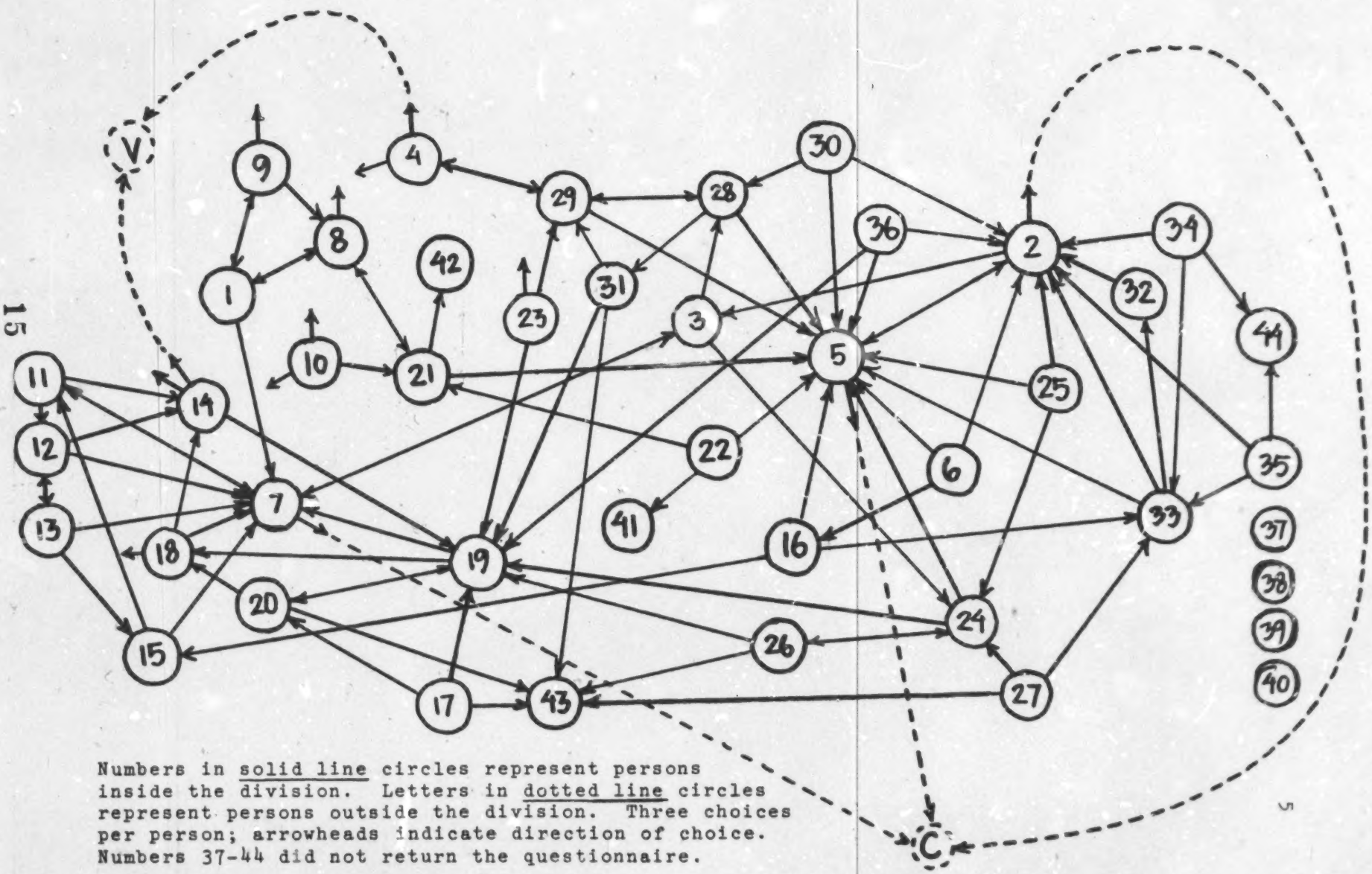
Low Technical Information Potential
Medium Technical Information Potential
Specialists
Superhigh Technical Information Potential

The category Low Technical Information Potential includes those not named as sources of information for any of the three kinds of technical information (i.e. "source of research/laboratory information", "source of technical information in general", and "source of state-of-the-art information"). The category Medium Technical Information Potential includes those named as sources for at least one of the three kinds of technical information by up to two people. The category Specialists includes those individuals designated by at least three of their colleagues as sources for technical information in one of the categories (It is interesting to note that specialists were identified only in the research/laboratory information and state-of-the-art information categories). Finally, in the Superhigh Technical Information Potential category are those individuals named by three or more persons as sources for each of at least two of the kinds of technical information considered. Our respondents distribute as follows:

Superhigh**	6
Specialist**	8
Medium	15
Low	15

**We can consider both Superhigh and Specialists as having high technical information potential, though of different kinds.

Table 1.2: Choices Designated as Sources of Technical Information



Numbers in solid line circles represent persons inside the division. Letters in dotted line circles represent persons outside the division. Three choices per person; arrowheads indicate direction of choice. Numbers 37-44 did not return the questionnaire.

2. Information Flow from Outside the Division

Differences in the information acquiring behavior of the respondents according to their information potential classification was examined. The number of unpublished professional or scientific reports read in the average month and the number of professional journals or periodicals read in the average month are shown in Table 2.1.

Table 2.1: Reports and Journals Read in the Average Month vs. Technical Information Potential Category

Number of unpublished professional or scientific reports read in the average month:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
8 - 80	50%	25%	36%	25%
2 - 7	17	38	36	50
0 - 1	33	38	27	25
TOTAL	100%	101%	99%	100%
Number of journals or periodicals read in the average month:				
7 - 14	50%	38%	46%	17%
4 - 6	50	25	27	25
0 - 3	0	38	27	58
TOTAL	100%	101%	100%	100%

As might be expected, the superhighs read more printed material than those in the other categories; with half of them reading eight or more unpublished reports and between seven and 14 journals or periodicals in an average month. Interestingly, the mediums tended to do more reading than did the specialists, while the lows did the least reading of the four categories.

The number of technical or professional meetings attended during the past year is shown in Table 2.2. Two-thirds of the superhighs have attended four or more meetings during the past year while more than half of the lows have attended one or no meetings during the past year.

Table 2.2: Number of Technical or Professional Meetings Attended During the Past Year vs. Technical Information Potential

Number of meetings attended during the past year:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
4 - 12	67%	38%	9%	25%
2 - 3	17	50	73	17
0 - 1	17	13	18	58
TOTAL	101%	101%	100%	100%

The research institute files were used to obtain documentary information regarding individual travel, telephone calls, and visitors received. Superhighs and specialists tended to travel more (see Table 2.3) in the sampled period than did the other groups.

Superhighs received more visitors, compared to the specialists and mediums, and all received far more visitors than the lows (see Table 2.4). Specialists and mediums made more long distance telephone calls than did the other groups in the sampled period (see Table 2.5).

Table 2.3: Number of Trips Recorded During August-September 1975 vs. Technical Information Potential

Number of trips during sampled two months:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=15)	Low (N=15)
2 - 4	33%	38%	27%	7%
1	17	13	7	13
0	50	50	67	80
TOTAL	100%	101%	101%	100%

Table 2.4: Number of Visitors Received During August-September 1975 vs. Technical Information Potential

Number of visitors received during sampled two months:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=15)	Low (N=15)
2 - 4	17%	13%	20%	0%
1	17	13	7	7
0	67	75	73	93
TOTAL	101%	101%	100%	100%

Table 2.5: Number of Long Distance Telephone Calls During the Period September 2-8, 1975 vs. Technical Information Potential

Number of long distance telephone calls during sampled week:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=15)	Low (N=15)
2 - 11	33%	50%	40%	20%
1	50	25	20	13
0	17	25	40	67
TOTAL	100%	100%	100%	100%

3. Professional Production and Recognition

The superhighs especially outdo all others in terms of the number of papers and articles published in the past five years and in terms of the number of professional meetings in which they have been program participants or have presented papers in the past year. As may be seen in Table 3.1, all but one of the superhighs have published two or more papers a year during the past five years. On the other hand, three-fifths of the lows published one or no papers in the same period. Table 3.2 shows that two-thirds of the superhighs were on the program or presented a paper at one or more professional meetings in the past year as compared with one-third of the lows.

Table 3.1: Number of Papers and Articles Published in the Past Five Years vs. Technical Information Potential

Number of published papers/articles in the past five years:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
8 - 30	83%	13%	46%	8%
2 - 7	17	88	18	33
0 - 1	0	0	36	58
TOTAL	100%	101%	100%	99%

Table 3.2: Number of Meetings in the Past Year Actively Participated in vs. Technical Information Potential

Number of active participations in professional meetings in the past year:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
3 - 5	33%	25%	18%	0%
1 - 2	33	25	46	33
0	33	50	36	67
TOTAL	99%	100%	100%	100%

The specialists stand out in terms of unpublished papers and reports as well as in terms of in-house presentations (i.e. scheduled meetings, seminars, etc.). Five of the eight specialists have written ten or more unpublished papers or reports in the past year (see Table 3.3). The data presented in Table 3.4 show that half

of the specialists participated in one or more presentations during a two month period as did a third of the superhighs. There was little such activity on the part of the mediums or lows.

Table 3.3: Number of Unpublished Papers or Reports Written During the Past Year vs. Technical Information Potential

Number of unpublished papers/articles in the past year:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
10 - 25	0%	63%	18%	0%
2 - 9	100	13	64	50
0 - 1	0	25	18	50
TOTAL	100%	101%	100%	100%

Table 3.4: Number of In-House Presentations (scheduled meetings, seminars, etc.) Given During August-September 1975 by Technical Information Potential

Number of presentations given in two months:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=15)	Low (N=15)
2 - 3	17%	38%	13%	7%
1	17	13	0	13
0	67	50	87	80
TOTAL	101%	101%	100%	100%

Though the number of patent applications filed in the past five years is shown in terms of percentage and categories of technical information potential in Table 3.5, the table is misleading. Forty-two patent applications were listed; three by superhighs, 13 by specialists, 25 by mediums and one by lows. However, one individual, characterized as being one of the medium group, accounts for 14 of the 42 or one-third of the total, while another individual, in the specialist category, accounts for eight, or about one-fifth of the total. This kind of distribution is not untypical of patent productivity within research and development groups.

Table 3.5: Number of Patent Applications Filed in the Past Five Years vs. Technical Information Potential

Number of patent applications during previous five years:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
3 - 14	0%	13	36	0%
1 - 2	33	50	0	8
0	67	38	64	92
TOTAL	100%	101%	100%	100%

In terms of professional recognition there appears to be a relationship between technical information potential and outside recognition (see Tables 3.6 and 3.7). In the past three years, the superhighs have been awarded more honors, awards, special committee chairs, editorships and have been listed in more professional

directories than have the other groups. Four of the six superhighs have received honors and four of them are listed in professional directories. Only two of the specialists, two of the mediums, and one of the lows have received honors in the sampled period.

Table 3.6: Professional Recognition in the Past Three Years (in the form of honors, awards, special committees, editorships, etc.) Received vs. Technical Information Potential

Number of times given professional recognition in the past three years:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
2 - 7	33%	13%	9%	0%
1	33	13	9	8
0	33	75	82	92
TOTAL	99%	101%	100%	100%

Table 3.7: Number of Professional Directory Listings vs. Technical Information Potential

Number of professional directory listings:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
3 - 4	33%	13%	18%	0%
1 - 2	33	25	27	0
0	33	63	55	100
TOTAL	99%	101%	100%	100%

One form of recognition by colleagues and peers is indicated by responses to the question where respondents were asked to choose the two persons with thom they would most like to work. There appears to be a strong relationship (see Table 3.8) between the number of people who express a desire to work with a person and his technical information potential.

Table 3.8: Number of Choices Received to the Question, "Who Would You Most Like to Work With" vs. Technical Information Potential

Number of "like to work with" choices received:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=15)	Low (N=15)
3 - 9	67%	38%	7%	0%
1 - 2	33	50	40	25
0	0	13	53	75
TOTAL	100%	101%	100%	100%

Table 3.9 indicates that aside from the clear cut difference between the lows (who tend to be new and young) and the others, there is little relationship between organizational rank and technical information potential. Table 3.10 would appear to reflect the project nature of the organization and the project leader role of the superhighs as differentiated from general administrative roles.

Table 3.9: Organizational Title or Rank of Groups vs. Technical Information Potential

Organizational rank or title:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=15)	Low (N=15)
Manager, section manager; vice president; director	33%	25%	27%	0%
Senior engineer, geologist, metallurgist, corrosion engineer, physicist; institute scientist; assistant director	50	50	47	14
Other scientists, engineers, and technicians, including technical editor, lab service supervisor	17	25	27	80
TOTAL	100%	100%	101%	100%

Table 3.10: Number of People Supervised vs. Technical Information Potential

Number of people supervised:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
6 - 9	50%	13%	27%	0%
1 - 5	33	50	18	8
0	17	38	55	92
TOTAL	100%	101%	100%	100%

Table 3.11 shows the extent to which the different groups were cited as sources of project/task information by their colleagues (as differentiated from the citations for technical information that were used to distribute the four groups). As can be seen in the table, there appears to be a fairly direct relationship between being cited as a source of project/task information and ranking in terms of technical information potential.

Table 3.11: Choices as Sources of Project/Task Information vs. Technical Information Potential

Number of choices as source of project/task information:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=15)	Low (N=15)
3 - 9	66%*	13%*	7%*	0%*
1 - 2	17	50	20	7
0	17	38	73	93
TOTAL	100%	101%	100%	100%

*Percentage of group receiving indicated number of choices

As can be seen in Table 3.12, there is little relationship between being cited as a source of project/task information and being cited as a person one would like to work with. However, there appears to be a very direct relationship between being cited as a source of technical information, state-of-the-art information and research/laboratory information and being cited as a person colleagues would like to work with (see Table 3.13).

Table 3.12: Number of Times Chosen as Source of Project/Task Information vs. "Like to Work With" Person

Number of choices as a source of project/task information:	Number of times chosen as one with whom they would like to work: 0 choices (N=21)	1-2 choices (N=15)	3-9 choices (N=8)
3 - 9	13%	20%	14%
1 - 2	38	27	14
0	50	53	71
TOTAL	101%	100%	99%

Table 3.13: Number of Times Chosen as Source of Technical Information, State-of-the-Art Information and Research/ Laboratory Information vs. "Like to Work With" Person

Number of choices as source of technical, state-of-the-art and research/laboratory information*	Number of times designated as "like to work with": 3-9 choices (N=8)	1-2 choices (N=13)	0 choices (N=16)
3 (N=30)	63%	31%	6%
1-2 (N=33)	29	36	25
0 (N=48)	8	33	69
TOTAL	100%	100%	100%

*N's in this column total 111 or three times the population for the three independent answers.

4. Diversity of information sources

Three aspects of how the respondents use information were examined: use of inside vs. outside sources, diversity of

information input and the relative use of different channels of communication.

One of the clearest patterns that can be seen in Tables 4.1, 4.2 and 4.3 is the large number of internal contacts maintained by the superhighs. This should be expected, by definition, since citation as a source of information by many colleagues was the basis of being identified as a superhigh. Nevertheless, the number and extent to which superhighs communicate with insiders is highly distinctive. These data parallel the findings of Pelz and Andrews* in their many studies which relate frequency and number of colleague contacts with productivity. In contradiction to the previous findings concerning high communicators (Allen's "gatekeepers"), superhighs were not found in the first rank in terms of outside colleague contacts (see Table 4.4).

Table 4.1: Number of Persons Within the Organization Communicated With Regularly about the Project or Task at Hand vs. Technical Information Potential

Number of project/ task contacts within the organization:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
9 - 35	100%	25%	36%	17%
5 - 8	0	50	18	42
1 - 4	0	25	46	42
TOTAL	100%	100%	100%	101%

*Scientists and Organizations Productive Climates for Research and Development, Pelz, Donald C. and Frank M. Andrews, John Wiley and Sons, Inc., New York, 1966.

Table 4.2: Number of Persons Within the Organization Communicated with Regularly about Research/Laboratory Techniques vs. Technical Information Potential

Number of research/ laboratory contacts within the organization:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
5 - 35	50%	13%	27%	42%
2 - 4	33	63	55	25
0 - 1	17	25	18	33
TOTAL	100%	101%	100%	100%

Table 4.3: Number of Persons Within the Organization Communicated With Regularly about the State-of-the-Art in any Field vs. Technical Information Potential

Number of state-of-the-art contacts within the organization:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
6 - 20	33%	25%	46%	8%
3 - 5	33	25	18	58
0 - 2	33	50	36	33
TOTAL	99%	100%	100%	99%

Table 4.4: Number of Professional Acquaintances Outside of the Organization with Whom Technical Information was Discussed During the Past Month vs. Technical Information Potential

Number of outside technical contacts during the last month:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
9 - 50	17%	63%	46%	8%
3 - 8	50	13	46	42
0 - 2	33	25	9	50
TOTAL	100%	101%	101%	100%

The percentage of unpublished reports read by the mediums that originated outside of the organization was higher than that found for the other groups (see Table 4.5).

Table 4.5: The Percentage of Unpublished Reports Read vs. Technical Information Potential

Percentage of unpublished reports originating outside the organization:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
75 - 100%	33%	25%	46%	33%
25 - 74%	50	38	27	17
0 - 24%	17	38	27	50
TOTAL	100%	101%	100%	100%

To get an impression of the diversity or the breadth of the information obtained by category of technical information potential, the respondents were asked to list the fields or specialties (e.g. personnel manager, chemist, propulsion expert, etc.) represented among their outside and inside contacts. Tables 4.6 and 4.7 show the number of fields mentioned for inside and outside contacts respectively. The most significant difference in both tables is between the superhighs/specialists as differentiated from the lows/mediums. In both tables the specialists mention a slightly greater number of different fields and specialties than do superhighs.

Table 4.6: Number of Fields or Specialties Represented by People Contacted Regularly Within the Organization vs. Technical Information Potential

Number of fields or specialties represented among within organization contacts:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
5 - 21	50%	63%	36%	8%
4	33	25	36	17
0 - 3	17	13	27	75
TOTAL	100%	101%	99%	100%

Table 4.7: Number of Fields Other Than Own Represented Among Outside Professional Acquaintances Contacted Within the Last Month vs. Technical Information Potential

Number of other fields represented among outside organization contacts:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
3 - 7	33%	50%	9%	8%
2	17	25	36	25
1	17	13	36	33
no professional contacts	33	13	18	33
TOTAL	100%	101%	99%	99%

If we take the number of different geographic areas called by phone during a week (as shown in Table 4.8) as one indicator of diversity, the general picture is the same as found in the previous tables. The greatest difference is found between the superhighs/specialists and the lows/mediums.

Table 4.8: Number of Different Areas Called in Long Distance Calls September 2-8, 1975 vs. Technical Information Potential

Number of different areas called during a week:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=15)	Low (N=15)
3 - 6	17%	25%	13%	7%
1 - 2	67	50	47	27
no long distance calls	17	25	40	67
TOTAL	100%	100%	100%	101%

5. Channels of communication

Totaling all outside communications, it was found that the telephone was most frequently used (46.4%) followed closely by face to face communication (39.4%). Writing was used infrequently and, then, more frequently by the specialists than the other groups (see Table 5.1). As might be expected face to face communications were used most frequently in-house (77.0%) and writing was used most infrequently (5.0%). In internal communications, again, it is seen that the specialists are sharply differentiated from the other groups in their larger use of written communications (see Table 5.2).

Table 5.1: Percentage of Outside Communication Contacts with Professional Acquaintances Made in Writing Last Month vs. Technical Information Potential

Percentage of outside contacts made in writing:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
25 - 100%	0%	50%	27%	17%
5 - 20%	67	13	27	8
0%	17	38	36	67
No professional outside contacts of any kind	17	0	9	8
TOTAL	101%	101%	99%	100%

Table 5.2: Percentage of Regular Communications Within the Organization Made in Writing vs. Technical Information Potential

Percentage of inside contacts made in writing:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
10 - 50%	33%	63%	27%	8%
1 - 5%	33	13	18	25
0%	33	25	55	67
TOTAL	99%	101%	100%	100%

The choice between using face to face contact or phone in communication with outside professional acquaintances differentiates the superhighs/specialists from the mediums/lows. Superhighs/specialists make a greater percentage of their outside contacts face to face and a lower percentage by phone than do those of low and medium technical information potential (see Tables 5.3 and 5.4).

Table 5.3: Percentage of Face to Face Outside Communication Contacts with Professional Acquaintances Last Month vs. Technical Information Potential

Percentage of outside contacts made face to face:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
75 - 100%	33%	38%	9%	25%
30 - 67%	50	50	27	25
0 - 25%	0	13	54	42
No professional outside contacts of any kind	17	0	9	8
TOTAL	100%	101%	99%	100%

Table 5.4: Percentage of Phone Outside Communication Contacts with Professional Acquaintances Last Month vs. Technical Information Potential

Percentage of outside contacts made by phone:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
67 - 100%	17%	25%	36%	25%
50 - 60%	17	13	46	33
0 - 40%	50	63	9	33
No professional outside contacts of any kind	17	0	9	8
TOTAL	101%	101%	100%	99%

For communications within the organization, the pattern is reversed. Superhighs/specialists use the phone in preference to face to face contact more than do the mediums/lows (see Table 5.5).

Table 5.5: Percentage of Regular Communications Within the Organization vs. Technical Information Potential

Percentage of inside contacts made face to face:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
25 - 50%	50%	50%	27%	25%
10 - 20%	33	25	36	50
0 - 9%	17	25	36	25
TOTAL	100%	100%	99%	100%

Percentage of inside contacts made by phone:	Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
90 - 100%	17%	38%	55%	50%
75 - 85%	33	25	9	33
25 - 65%	50	38	36	17
TOTAL	100%	101%	100%	100%

6. Education and experience

The degree levels attained by the respondents and the fields in which they have been attained are, of course, a function of the nature of the division and its hiring policies. Of the 37 respondents, 11 hold doctorates, an additional 13 hold masters degrees, 11 hold bachelors degrees and two have some college.

Tables 6.1 and 6.2 show the highest achieved university degree and the field within which it was achieved vs. technical information potential. Half of the specialists and half of the lows have bachelors degrees. Half of the mediums and two-thirds of the superhighs hold doctorates. All of the superhighs, two-thirds of the mediums and three-fourths of the lows graduated within physics, mechanics, or aerospace engineering. The specialists show a greater variety of fields; half of them got their degrees within some specialty of material sciences, metallurgical or chemical engineering, chemistry of geology.

Table 6.1: University Training: Highest Degree Achieved vs. Technical Information Potential

University training: highest achieved degree:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
Doctorate	67%	13%	46%	8%
Masters degree	0	38	46	42
Bachelors degree or some college	33	50	9	50
TOTAL	100%	101%	99%	100%

Table 6.2: University Training: Field of Highest Degree Achieved vs. Technical Information Potential

University training: field of highest degree:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
Material Science, metallurgical engineering, ceramic engineering, chemistry, geology	0%	50%	27%	8%
Mechanics, mechanical engineering, physics, math/physics, aerospace engineering	100	38	64	75
Other: civil engineering, electrical engineering, English	0	13	9	17
TOTAL	100%	101%	100%	100%

Age is partly related to education and sets an upper limit for the number of years available for experience. As shown in Table 6.3 age is fairly well correlated with technical information potential. Two-thirds of the superhighs are older than 40 years, whereas two-thirds of the lows are 35 or younger.

The number of organizations a person has been with in his professional career sets another limit on his experience. Table 6.4 shows that one-third of the superhighs have been with three or four organizations, while half of them have been with two organizations. Half of the specialists and mediums have been with three or more organizations in their professional career. Half of the lows have most often been with only one organization (clearly a function of their age).

Table 6.3: Age vs. Technical Information Potential

Age: years old:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
41 - 57	67%	38%	27%	8%
36 - 40	17	50	36	25
23 - 35	17	13	36	67
TOTAL	101%	101%	99%	100%

Table 6.4: Number of Organizations Worked in vs. Technical Information Potential

Number of organizations in professional career:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
3 - 4	33%	50%	54%	25%
2	50	50	18	25
1	17	0	27	50
TOTAL	100%	100%	99%	100%

As can be seen in Table 6.5, the superhighs tend to have had the longest tenure with the present organization followed by the specialists and mediums. As would seem fitting, specialists show the most prolonged experience (16-33 years) in their current specialty (see Table 6.6). However, the specialists are followed closely by the superhighs and mediums in number of years of experience within current field. The lows are the most inexperienced in every sense.

Table 6.5: Number of Years with Present Organization vs. Technical Information Potential

Number of years of experience with present organization:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
11 - 25	67%	50%	46%	8%
6 - 10	33	38	27	25
0 - 5	0	13	27	67
TOTAL	100%	101%	100%	100%

Table 6.6: Number of Years of Technical Experience in Specific Fields Currently Working in vs. Technical Information Potential

Number of years of technical experience in specific field:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=11)	Low (N=12)
16 - 33	33%	38%	27%	8%
11 - 15	50	25	46	17
1 - 10	17	38	27	75
TOTAL	100%	101%	100%	100%

7. Spatial aspects of communication

Space is a barrier to interaction. Thus, distance should be expected to influence the ease with which communication flows in different directions. The division under study is located in a three story building. The experienced distance bewween any two persons in the building was determined according to an ordinal scale, where each value was expected to represent an equal experienced increase in energy expended. The distance values used were the following:

1. next office
2. two offices away
3. three offices away
4. others on the same floor
5. others on the next floor
6. others two floors apart
7. another building.

The number of choices made on each of the five criteria (mentioned earlier) as well as the possible number of contacts at the different distance levels was counted. Although it was realized that the jump between distance-level 3 and 4, and particularly 4 and 5 and 6 and 7 may be greater than the other scale intervals in terms of energy expended, it turns out that there were choices made at every distance level (see Tables 7.1 and 7.2).

Table 7.1: Percentage of Persons Named on Different Criteria of Choice vs. Different Distance-Levels from Point of Choice

Distance levels:	Percentage of persons named as source of a type of information within designated distance:				
	Project/ task (N=67)	Res./lab. technique (N=69)	Tech- nical (N=71)	State- of-art (N=70)	Like to work with (N=62)
Next office	4%	8%	8%	11%	13%
Two offices away	4	4	7	6	6
Three offices away	7	10	7	7	5
Others on same floor	18	15	16	17	10
Others on next floor	39	30	32	30	44
Others two floors apart	4	16	16	19	13
Another building	22	16	14	10	10
TOTAL	98%	99%	100%	100%	101%

Table 7.2: Number of Persons Named on Different Criteria of Choice vs. Different Distance-Levels from Point of Choice Related to Number of Possible Choices at the Distance-Level

Distance levels:	Probability of an information-choice between two persons at designated distance:				
	Project/ task infor- mation	Res./lab. technique informa- tion	Tech- nical infor- mation	State- of-art infor- mation	Like to work with relation
Next office	.05	.10	.10	.13	.13
Two offices away	.06	.06	.09	.08	.08
Three offices away	.08	.11	.08	.08	.05
Others on same floor	.04	.03	.03	.04	.02
Others on next floor	.03	.02	.03	.02	.03
Others two floors apart	.01	.04	.04	.04	.03
Another building	.01	.01	.01	.00	.00

The probability of choices decreases with increasing distance in a fairly smooth manner, in spite of the inequality of the scale steps. Table 7.3 shows on which floor persons of different technical information potential are situated. Half of those of high technical information potential have offices on the first floor, half of the mediums on the second floor and half of the lows on the third floor.

Next, all the offices were classified according to distance from the two staircases in the building; one, two, three, and four or more offices away from a staircase. As shown in Table 7.4, those who sit nearest the staircases receive the greatest number of

designations as sources for technical information, research/ laboratory techniques or state-of-the-art. Two-thirds of the superhighs sit next to a staircase, half of the specialists, one-third of the mediums, but none of the lows.

Table 7.3: Floor at Which Groups of Different Technical Information Potential Have Their Offices Located

Floor on which office is located:	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=15)	Low (N=15)
First floor	50%	50%	20%	20%
Second floor	33	38	53	27
Third floor	17	12	27	53
TOTAL	100%	100%	100%	100%

Table 7.4: Number of Offices From the Nearest Staircase vs. Technical Information Potential

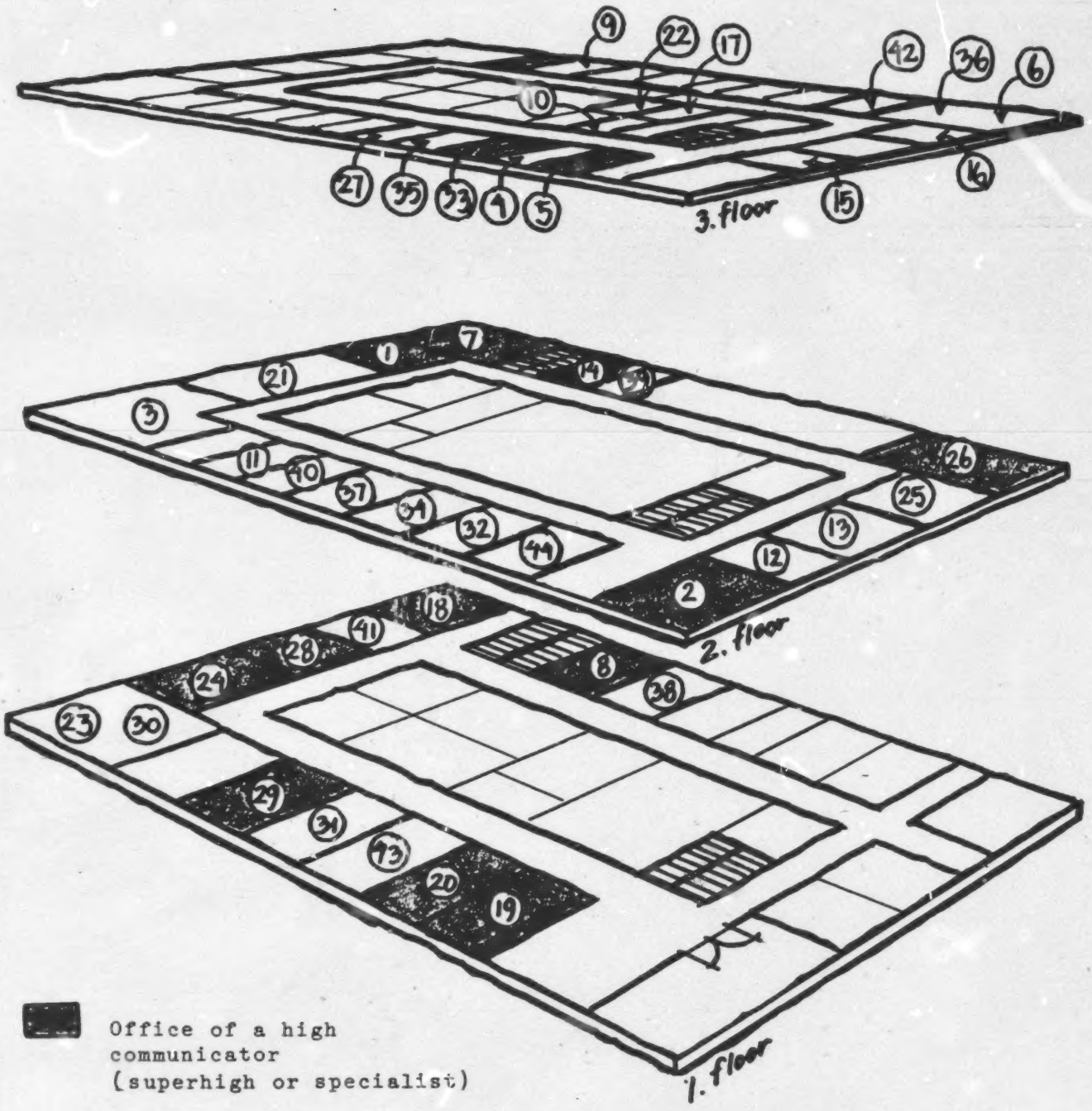
Number of offices removed from nearest staircase	Technical information potential: Superhigh (N=6)	Specialists (N=8)	Medium (N=15)	Low (N=15)
Next to staircase	67%	50%	33%	0%
Two offices away	0	25	20	20
Three offices away	17	25	27	33
Four or more away	17	0	20	47

When both the floor and distance from a staircase is taken into consideration, the probability of persons turning into any given office to get an answer to a technical question can be predicted with a fairly high probability as may be learned from Table 7.5. Table 7.6 shows the spatial location of high communicators.

Table 7.5: Technical Information Potential as a Function of Distance from Staircase and the Floor on Which a Person's Office is Located

Technical information potential:	Location of office: Near the staircase (1-2) 1 floor (N=7)	2 floor (N=10)	3 floor (N=4)	Not near the staircase (3+) 1 floor (N=6)	2 floor (N=8)	3 floor (N=9)
High	71%	40%	25%	33%	13%	11%
Medium	14	50	50	33	50	11
Low	14	10	25	33	38	78
TOTAL	99%	100%	100%	99%	101%	100%

Table 7.6: Spatial location of the offices of high communicators and others in the building



Office of a high communicator (superhigh or specialist)

Numbers in circles refer to individuals included in this survey

ATTACHMENT 3

Introspective Evaluation of Experience with Search Using Automatic Subject and Citation Alert (ASCA) of ISI

The Automatic Subject and Citation Alert (ASCA) is a computerized search system which examines all the new articles published in a wide range of journals on a weekly basis. The results of each search are forwarded to the subscriber, upon completion of the run, in the format shown in Figure 1. The search profile is based on words (roots) in the title and cited authors selected by the subscriber.

For the four month period October 1975 through January 1976, ASCA was used with profiles supplied by the chief investigator. The initial profile (Figure 2) was used from the beginning of the study through the second week in December. At that time, the results were examined and the profile changed in hopes of improving the results for the remainder of the study (Figure 3).

Each bibliographic entry was judged by the principal investigator with a view to whether the article was relevant and worth the effort to obtain.

FIGURE 1

Sample of ASCA Reports

a s c a ®

AUTOMATIC SUBJECT CITATION ALERT

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INSTITUTE FOR SCIENTIFIC INFORMATION
325 Chestnut St Philadelphia Pa 19106 USA
Telephone 215/923-3300 Cable SCINFO Telex 84-5305

ALBERT SHAPERO
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MANAGEMENT DEPT.
BEB-525
AUSTIN, TEXAS 78712

DT700 ACCT NO
269 $ UNITS USED
0000 $ UNITS UNUSED
S 1
DT700

REPORT FOR 05 DEC 75 THIS SUBSCRIPTION EXPIRES 30 JAN

311.508 INDEXING TERMS FROM CURRENT SCIENTIFIC LITERATURE WERE PROCESSED FOR ASCA THIS WEEK.

INFORM/ ANALYSIS
ANALYSIS OF RESEARCH EFFICIENCY - COSTS AND INFORMATION GAIN
MIDLARSK.M MIDLARSK.E
PSYCHOL REP 37(2): 607-617.1975 16 REFS
-----> CHECK TO ORDER TEAR SHEETS ----->( ) #AV746
M MIDLARSK., UNIV COLORADO, BOULDER, CO 80302

INFORM/ SCIENTI/
PULLING MINDS OF SOCIAL SCIENTISTS TOGETHER - TOWARDS A WORLD SOCIAL-SCIENCE INFORMATION-SYSTEM
ADAM R
INT SOC SCI 27(3): 519-531.1975 54 REFS
THESE ITEMS IN YOUR PROFILE WERE CITED:
GARVEY WD COLLOQUIUM IMPROVING 68
GARVEY WD II JOHNS HOPK U CTR 70
-----> CHECK TO ORDER TEAR SHEETS ----->( ) #AV659
R ADAM, CITY UNIV LONDON, LONDON, ENGLAND

INFORM/ ENGINEER/ SCIENTI/ TECHNICAL
(RS) SCIENTIFIC AND ENGINEERING SOCIETIES IN USSR AND SCIENTIFIC AND TECHNICAL-INFORMATION
LANTSBER.GS
NAU T INF 11975(10): 3-9.1975 15 REFS
-----> CHECK TO ORDER TEAR SHEETS ----->( ) #AV789

INFORM/ SCIENTI/
(RS) TECHNOLOGICAL-FORECASTING AND SCIENTIFIC INFORMATION
VLADIKOV.V
NAU T INF 11975(10): 24-26.1975 NO REFS
-----> CHECK TO ORDER TEAR SHEETS ----->( ) #AV789

OF CONFERENCES AND REVIEWS
GARFIELD E
CURR CONTEN1975(48): 5-8.1975 10 REFS
THESE ITEMS IN YOUR PROFILE WERE CITED:
PRICE DJD SCIENCE 149 510 65
-----> CHECK TO ORDER TEAR SHEETS ----->( ) #E7816
E GARFIELD, INST SCI INFORMATION, PHILADELPHIA, PA 19106

FOR OATS® SERVICE, MARK ITEMS WHERE INDICATED ABOVE ( ) AND SEE ORDERING INSTRUCTIONS ON BACK OF FORM.

FIGURE 2

ASCA Profile 1

TERM NO.	NAME.INITIALS OR OTHER TERM	CITED PUBLICATION OR (CLASS OF TERM)	VOL (TYPE)	LOW PAGE	HIGH PAGE	YR	S
1	ROGERS EM	COMMUNICATION INOVAT					3
2	ALLEN TJ	(CITED AUTHOR)					9
3	BRITTAIN MJ	(CITED AUTHOR)					9
4	COLE JR	(CITED AUTHOR)					9
5	COLE S	(CITED AUTHOR)					9
6	CRANE D	(CITED AUTHOR)					9
7	GARVEY WD	(CITED AUTHOR)					9
8	HOLLAND WE	(CITED AUTHOR)					5
9	PRICE DJD	(CITED AUTHOR)					9
9A	PRICE DDS	(CITED AUTHOR)					
11	UTTERBACK JM	(CITED AUTHOR)	Levels				9
12	COMMUNICAT/	(WORD)	(1 M1)	MB			10
13	INFORM/	(WORD)	(1 M2)	MD			8
14	ANALYSIS	(WORD)	(1 M3)	MF			51
15	SOURCE/	(WORD)	(1 M3)	MF			15
16	SCIENTI/	(WORD)	(1 M3)	MF			5
17	TECHNICAL	(WORD)	(1 M3)	MF			5
18	INDUSTRIAL	(WORD)	(1 M3)	MF			6
19	NON PROFIT	(WORD)	(1 M3)	MF			7
19A	NONPROFIT	(WORD)	(1 M3)	MF			
20	PATTERN/	(WORD)	(1 M3)	MF			14
21	MANAGER/	(WORD)	(1 M3)	MF			6
22	ENGINEER/	(WORD)	(1 M3)	MF			12
23	CHANNEL/	(WORD)	(1 M3)	MF			10
24	USE	(WORD)	(1 M3)	MF			6
25	BEHAVIOR/	(WORD)	(1 M3)	MF			32
		TOTAL # NOW IN USE					269

FIGURE 3

ASCA Profile 2

TERM NO.	NAME.INITIALS OR OTHER TERM	CITED PUBLICATION OR (CLASS OF TERM)	VOL (TYPE)	LOW PAGE	HIGH PAGE	YR	$
1	ROGERS EM	COMMUNICATION INOVAT					3
2	ALLEN TJ	(CITED AUTHOR)					9
4	COLE JR	(CITED AUTHOR)					9
5	COLE S	(CITED AUTHOR)					9
6	CRANE D	(CITED AUTHOR)					9
7	GARVEY WD	(CITED AUTHOR)					9
12	COMMUNICAT/	(WORD)	(1 M1)	MB			10
13	INFORM/	(WORD)	(1 M2)	MD			8
16	SCIENTI/	(WORD)	(1 M3)	MF			5
17	TECHNICAL	(WORD)	(1 M3)	MF			5
18	INDUSTRIAL	(WORD)	(1 M3)	MF			5
20	PATTERN/	(WORD)	(1 M3)	MF			14
23	CHANNEL/	(WORD)	(1 M3)	MF			10
24	USE	(WORD)	(1 M3)	MF			5
26	LIN N	(CITED AUTHOR)					9
27	CRAWFORD SY	(CITED AUTHOR)					9
28	GRIFFITH B	(CITED AUTHOR)					9
29	HAGSTROM WO	(CITED AUTHOR)					9
30	WHITLEY RD	(CITED AUTHOR)					9
31	ZALTMAN G	(CITED AUTHOR)					9
32	LINE MB	(CITED AUTHOR)					9
33	PAISLEY WT	(CITED AUTHOR)					9
34	PRESCOTT S	(CITED AUTHOR)					9
35	INFORM/	(WORD)	(1 M1)	MB			8
36	NEED/	(WORD)	(1 M3)	MF			10
37	NETWORK/	(WORD)	(1 M3)	MF			10
		TOTAL $ NOW IN USE					219

As can be seen in Figure 4, using Profile 1, ASCA produced 157 bibliographic items of which 31 were considered hits (19.7%). After the results were reviewed and the profile changed, the hits fell to 30 out of 287 bibliographic references (10.5%) for Profile 2. It was found, however, that in Profile 2 a misunderstanding of the way the system works had elicited two ways of using the term "information" which resulted in a very high number of reject referrals. Correcting for the clumsy usage, ASCA produced 19 hits out of a total of 71 for a success ratio of 26.4%.

FIGURE 4

	HITS	NON-HITS			SUCCESS RATIO
	(1)	(2) Other Interests (Non Project Relevant)	(3) Rejects	(4) Total Non-Hits (2)+(3)	(1) / (1)+(4)
Profile 1	31	29	97	126	.197
Profile 2	30	29	228	257	.105
Profile 2-corrected to remove use of inform twice (inform/inform)	19	10	43	53	.264
Profiles 1 plus 2--corrected	50	39	140	179	.218
Profiles 1 plus 2-corrected plus Deletion of all foreign items	47	39	111	150	.239

A more detailed analysis of the effectiveness of the individual author and root terms used is shown in Figure 5. Three cited authors produced one hit each. One author, Rogers, resulted in two hits. Another author, Crane, resulted in two hits, and in various combinations with Allen, Cole, and Price, resulted in three more hits. The authors, Garvey, Crane, and Price each resulted in a hit. The combinations of terms that resulted in the greatest numbers of hits were communication/information (three hits), communication/ pattern (two hits), information/analysis (two hits). Several other combinations resulted in one hit each.

As can be seen in Figure 5, the corrected Profile 2 which was developed after consideration of Profile 1 results improved results moderately. The most productive terms were "information" by itself which resulted in eleven hits (and 220 non-hits), information/ need, communication/technical, and communication/scientist (the latter combinations resulted in two hits each).

FIGURE 5

Hits Produced by Specific Authors Cited and Root Terms

PROFILE 1				PROFILE 2 (corrected)			
Author or term	+ Author or term	+ Author or term	= Hits	Author or term	+ Author or term	+ Author or term	= Hits
Cole, S.			1	Cole, S.			2
Cole, J.R.			1		+ Crane, D.		1
Allen, T.J.			1		+ Cole,J.R.(2)	+Hagstrom	1
Rogers E.M.			1	Cole, J.R.			1
	+ Rogers (2)*		1	Rogers, E.M.			1
Crane, D.			2	Crane, D.			1
	+ Allen (2)		1	Whitley, R.D.(2)			1
	+ Allen(2)	+Cole,S.(3)	1				
	+ Price, D.D.S.		1				
Garvey, W.D.			0				
	+ Crane(2)	+Price (2)	1				
Communicat/Analysis			1	Communication/Technical			2
	Behavior		1		Scienti		2
	Channel		1		Pattern		1
	Inform		3		Inform		1
		+Allen	1	Inform/			11
	Pattern		2		Need		2
	Scienti		1		Scienti		1
Inform/Analysis			2				
		+Holland,W.	1				
	Behavior		1				
	Channel		1				

Industrial	1		
Technical	1		
Source	1		
Scienti/Technical	1		
Garvey (2)	1		
TOTAL	31	TOTAL	30

* Citations

Data were kept on references that were of interest to the evaluator but which were not relevant to the project; referred to in the attached figures as other interests (not project relevant). Profile 1 produced 29 such references (18.9%) and the corrected Profile 2 produced 10 (13.7%); the results compare with previous studies which showed scientists and engineers finding 18% or 19% of their valuable information "by accident".

One interesting aspect of the search is concerned with articles in foreign languages. In most cases, an article listed as being in a foreign language was judged as not worth the effort of locating unless the reference stated there was a translation or an English abstract. The few exceptions were articles that looked so promising that the required extra effort was considered justified. In Profile 1, three Russian articles were judged hits; in Profile 2 one German article was considered of interest, but not project relevant. Rejected foreign language articles comprised 78 (34%) of the total number of references received (see Figure 6).

FIGURE 6

Foreign Articles

	PROFILE 1		PROFILE 2	
	Hits	Non-Hits	Hits	Non-Hits
Russian (RS)	3	13		16
German (FE)		4		24
French (FR)		4		9
Spanish (SP)				3
Swedish (SW)				2
Slavic (SL)				1
Czeck (CZ)				1
Dutch (DU)				1
Hungarian (HU)		1		
TOTAL	3	22	0	57